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Impacts of Whale-Watching on Blue Whales (*Balaenoptera musculus*) off Southern Sri Lanka

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ABSTRACT
Blue whales inhabit the coastal waters off southern Sri Lanka throughout the year, due to a narrow continental shelf and upwelling, related feeding opportunities. A busy, international shipping lane also lies off the south coast. While blue whales are listed on the IUCN Red List of Threatened Species, the subspecies status and genetic affinities of this northern Indian Ocean population is not well understood. Since 2009 a rapidly expanding, boat-based, commercial whale-watching industry has developed off the south coast, but remains unregulated due to the non-existence of national regulations or codes of conduct. As a result, unethical practices are leading to harassment of the targeted whales. Comparison of sightings data from before and after whale-watching began, shows a shift in the area of occurrence and concentration of whales. Simultaneously there is an increase in the number of stranding and vessel collision related mortality. These factors indicate that current whale-watching practices are displacing whales from their preferred feeding areas and inadvertently pushing them offshore into the shipping lane, causing an increase in fatal vessel collisions. It is recommended that a precautionary principal is followed and whale-watching activities are regulated as a priority, in order to mitigate any adverse impacts.

KEYWORDS: blue whale, unregulated whale-watching, displacement, impact mitigation.

INTRODUCTION
Sri Lanka (N 5° 55´ - 9° 50´; E 79° 42´ - 81° 53´) is a developing tropical island nation in the northern Indian Ocean (Fig. 1) where tourism is expanding rapidly. Though small in size (65,000 km^2), the island is well endowed with natural attractions and nature based tourism has become increasingly important in recent decades. The blue whale (*Balaenoptera musculus*) is a common species of large mysticete in the waters around Sri Lanka (Leatherwood and Reeves, 1989; Ilangakoon 2002, 2006) and sighting rates are high in comparison to other low-latitude regions of the world (Branch *et al.*, 2007). Off southern Sri Lanka where the continental shelf is narrow, primary productivity is driven by monsoon-related upwelling (Vinayachandran & Mathews, 2003; Vinayachandran *et al*., 2004) and blue whales taking advantage of feeding opportunities are predictably found in coastal waters throughout the year.

Whale-watching is one of the fastest growing sectors of nature tourism throughout the world (Hoyt, 2001).The impact of high levels of boat-based tourism and related disturbance on target cetacean populations has now become a cause for concern (Constantine, 2001; Bejder *et al*., 2006a, 2006b; Schaffar & Garrigue, 2008; Steckenreuter *et al*., 2012).This trend is of particular concern in developing countries where regulations are nonexistent or not strictly enforced (Stensland and Berggren, 2007). Since 2009, a boat-based, commercial whale-watching industry is developing off the fisheries port of Mirissa on the south coast of Sri Lanka (Fig. 1). Although these waters contain a diversity of cetacean species (Ilangakoon, 2012a), currently the whale-watching industry primarily targets the blue whale because it is impressively large and charismatic which makes it more marketable than other species. While the numbers of boats and

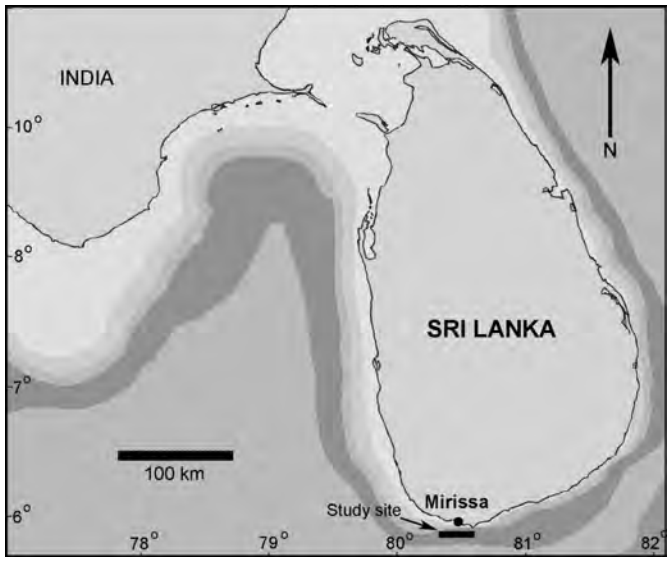

Fig.1. Location map of study area

tourists engaged in whale-watching activities are increasing annually, this rapidly expanding industry remains unregulated in any formal (rules and regulations) or informal (voluntary codes of conduct, best practice guidelines) manner because no such mechanisms exist within the country. Empirical observations suggest that increased competition among whale-watch operators and a lack of knowledge regarding whale biology and behavioural ecology is leading to unethical practices and the harassment of animals.

Sri Lanka's central location on the main East -West trade route across the Indian Ocean means that a busy, international shipping lane lies just off the southern coast. The island's main port Colombo, situated on the west coast, is developing as a transhipment hub in the region and with increasing shipping traffic, an increase in the vessel collision related mortality of whales has been recorded within the last decade (Ilangakoon, 2006, 2012b).

This paper is a preliminary attempt to discern whether blue whales off the south coast of Sri Lanka are being adversely impacted by whale-watching activity, through examining sightings and stranding data from before and after the inception of commercial whale-watching in the area.

METHODOLOGY

Cetacean diversity surveys were carried out over twenty field days between September 2008 and April 2009, using standard line transect methodology off the south coast of Sri Lanka (Ilangakoon & Perera, 2009; Ilangakoon, 2012a). For this paper, blue whale sighting records were extracted and compiled from the results of these surveys along with sighting locations. Ten field days were spent in January 2011 off the south coast, specifically for the purpose of finding blue whales and noting the locations of any encounters (Ilangakoon, unpublished data). These two sets of data were collated and mapped along with important bathymetric features and the main shipping lane. This map was used to examine whether the area of occurrence and concentration had changed between 2008 when there was no commercial whale-watching and 2011, the third year of whale-watching. For the present analysis, sightings have been recorded as sighting events without considering the number of animals present at each.

All published records of blue whale strandings that occurred on the south and west coast of Sri Lanka from 1894 (earliest available record) were initially extracted from existing published compilations of cetacean strandings (Ilangakoon, 2002, 2006; Ilangakoon and Sathasivam, 2012). Strandings occurring more recently and not yet reported in the literature were added to the list then included in this analysis if the specimens had been examined personally and authenticated as being blue whales. Subsequently, the data were divided into blue whale strandings occurring before and after 2010, for examination in relation to the whale-watch industry.

The increase in the number of boats engaged in whale-watching activities from the fisheries port of Mirissa, which was also the location from which the cetacean sighting surveys were conducted, was considered from the inception of whale-watching in 2009 until 2011. The behaviour and approach methods of the whale-watch boats were opportunistically observed whenever encountered. This data, not being quantifiable, is insufficient for analysis and therefore is used here only as supplementary information.

RESULTS

A total of fifty-one blue whale sighting events were compiled for the entire period between 2008 and 2011. During cetacean diversity surveys in 2008/2009, sixteen blue whale sightings were recorded with a concentration of sightings in close proximity to the continental shelf edge (Fig.2) where feeding was observed (Ilangakoon, 2012a). In January 2011, thirty five blue whale sightings were recorded with the area of occurrence and concentration located further offshore in deeper waters, southwest of sighting locations recorded in 2008/2009 (Fig.2). Mother-calf pairs and feeding activity were observed during all surveys.

A total of nineteen blue whale strandings were recorded for the south and west coast from 1894 to the present. Of these, thirteen (68%) occurred in the 115-year period before 2010, while 6 (32%) occurred in the two-year period between January 2010 and December 2011 (Fig.3).

The number of regular whale-watch boats operating from the fisheries port of Mirissa in early 2009

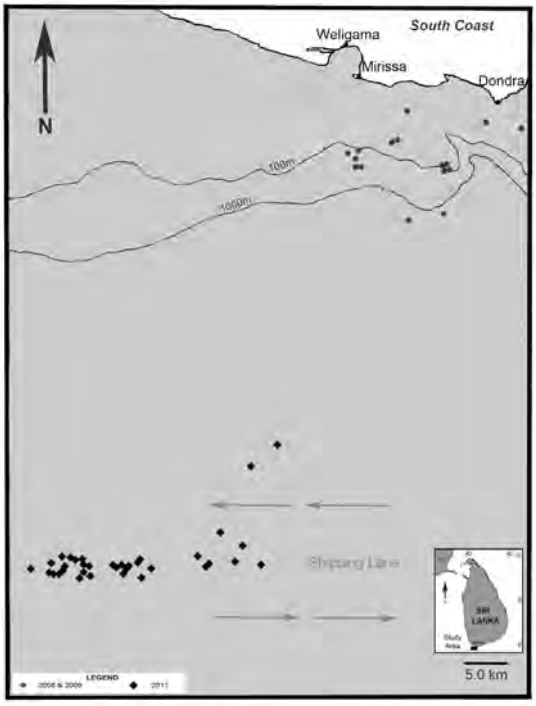

Fig.2. Blue whale sightings off southern Sri Lanka

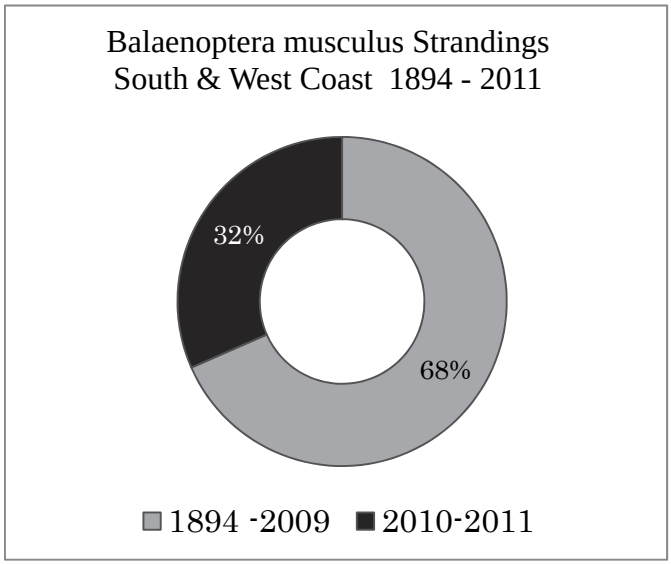

Fig.2. Blue whale strandings off the south and west coast of Sri Lanka

was a mere two. By 2011 the number of boats specifically engaged in whale-watching had increased to thirteen (sizes varying between 6m and 25m) while several more small fishing boats (with outboard engines 15-25hp) take people out whale-watching on an irregular basis. Most whale-watch boats were seen to approach whales in an inappropriate and unethical manner that constituted harassment. Though not quantifiable, some of the inappropriate actions observed included approaching at high speed, constantly changing direction and speed close to animals, approaching the animals very closely (within 10m) in a manner that was dangerous both to the animals and to the whale-watchers, approaching head-on and surrounding and chasing directly from behind when whales tried to avoid boats. These actions prevented the whales from staying on the surface long enough to replenish their air supply after engaging in foraging dives, as they were often forced to dive hurriedly in order to avoid the boats.

DISCUSSION

The data shows a clear indication that unregulated whale-watching off southern Sri Lanka is having an impact on the target population of blue whales in the study area. Sighting data indicates a clear shift in area of concentration before and after the inception and exponential growth of commercial whale-watching over a short span of only three years. Although it is possible that this shift could be due to other reasons like prey availability or oceanographic conditions, similar displacement has previously been reported in studies on killer whales (Lusseau *et al*., 2009) and humpback whales (Sousa-Lima *et al.*, 2002) subjected to whale-watching activity elsewhere in the world. Displacement of blue whales from favoured feeding grounds along the continental shelf edge is a cause for concern, as being forced to feed in deeper suboptimal waters could lead to a decrease in foraging efficiency and an increase in their energy needs. Physiologically important activities like foraging and resting are essential for cetaceans to remain healthy (Parsons and Scarparci, 2010).If whale-watching is affecting these blue whales in a manner that reduces the time spent on such activities, it could result in significant long-term impacts in the form of compromised health and reproductive success, as reported for other cetacean populations (Constantine *et al*., 2004; Gregory and Rowden 2001; Sousa-Lima and Clark, 2009). Harassment by whale-watch boats has to be extremely severe to cause this kind of shift in distribution, even though the displacement is presently over a relatively short distance.

More disturbing is the fact that the whales are being displaced from relatively safe coastal waters into the shipping lane, where they are more vulnerable to accidental vessel collisions that are likely to be lethal, given the fact that very large vessels constantly ply this rout. The present data indicates a sudden increase in the number of blue whale strandings on the south and west coast in the last two years, accounting for 32% of total strandings since 1894. This increase coincides with the development of whale-watching and the consequent shift in area of whale concentration. There is a distinct possibility that this recent rise in whale mortality is connected to the fact that the whales are now increasingly foraging in the shipping lane. While there is already one record of a blue whale struck by a container vessel then being carried into the Colombo harbour on the bow of the respective vessel (Ilangakoon 2006), at least some of the recently stranded animals have shown clear signs of blunt force trauma and propeller lesions when beached. Others have been in an advanced state of decomposition and therefore it was not possible to clearly define the cause of death. The number of collisions is probably greater than the recorded strandings, because carcases that get washed out to sea or sink after a collision are never recorded and this could vary with the seasons and prevailing current patterns. Blue whales are also prone to vessel collisions elsewhere in the world, such as the west coast of USA, where their habitat overlaps with shipping routes (Douglas *et al*., 2008).

While blue whales are listed as endangered in the IUCN Red List of Threatened Species, the fact that unregulated whale-watching is already having adverse impacts on the population off southern Sri Lanka is of particular concern, because the ecology, demography and population affinities of blue whales in this region are not yet clearly understood. It has been suggested that there is a resident population in the northern Indian Ocean (Leatherwood and Reeves, 1989; Alling*et al*., 1991; Balance and Pitman, 1998; Ilangakoon, 2002, 2006b;

Ilangakoon and Sathasivam, in press) with a geographical distribution that does not overlap with other Indian Ocean populations (Mikhalev, 2000; Branch *et al*., 2007) and a breeding cycle that is out of phase with those of the southern Indian Ocean (Mikhalev, 2000). Accordingly, if this population does not interbreed with other populations they may be genetically isolated and more recently, Ilangakoon & Sathasivam (2012) raised the possibility of a separate northern Indian Ocean subspecies (*Balaenoptera musculus indica*). This was based on observations of extremely localized movements with year-round occurrence around Sri Lanka, presence of mother-calf pairs along with feeding and breeding activity and unusual morphological traits and behavioural characteristics which differentiates them from the two currently recognized subspecies (*B. m. brevicauda* and *B. m. intermedia*) in the Indian Ocean and Southern Ocean. There is also no doubt that the waters around Sri Lanka are important to these whales as a feeding ground and possibly a breeding area (Alling *et al*., 1991; Ilangakoon, 2002, 2011; Ilangakoon and Sathasivam, 2012). Since demographic parameters and genetic structure for this population are as yet unknown, any anthropogenic impacts need to be minimized as they could have population-wide conservation and management implications.

Therefore, based on these preliminary results, it is recommended that a precautionary principal is followed and that Sri Lanka enacts and implements national whale-watching regulations as a priority in order to prevent any further harassment and adverse impacts on these whales. This is particularly urgent as the whale-watching industry is growing rapidly and if not regulated quickly, the adverse impact of increasingly unethical, human behaviour may become irreversible. Such impacts would, in the long-term, have adverse effects not only on the target whale population but also for the whale watching industry itself. The whales are doubly impacted due to both the increased probability of direct mortality through vessel collisions and the possibility of population-wide, biological impacts through changes in behaviour, foraging efficiency and fecundity. Likewise, as whales take evasive action and move further away from the coast due to constant harassment, search times will increase for whale-watch vessels leading to higher costs and eventually making the industry unsustainable in the long-term.

This industry can be successfully regulated only if formal and informal regulatory mechanisms that compliment each-other are implemented. This can be done through:

a. Formal rules and regulations that are enacted by law and can be enforced by relevant authorities.
b. Voluntary codes of conduct developed with the concurrence of those engaged in and benefiting from the whale-watch industry.
c. Education and awareness creation among whale-watch operators, guides, tourism industry personnel, law enforcement authorities, whale-watching tourists and local communities.

Meanwhile, there is an urgent need for more quantitative research and monitoring of developments in relation to whale-watching, its impact on target animals and consequent behavioural changes in the whales following this preliminary study. This type of data is crucially important to enable informed management decisions and to ensure whale-watching is regulated in a scientific manner.

Properly regulated and carefully developed whale-watching with long-term sustainability in mind will bring economic benefits to the country, benefit the local communities in southern Sri Lanka and provide spectacular whale-watching opportunities for tourists. If properly managed and protected, without the excessive disturbance in their natural habitat which can affect the quality of their life cycle, these blue whales will be a valuable resource with high, non-consumptive, economic potential. Regulating the whale-watching industry without further delay will be the only way to ensure the continued survival of this whale population in their favoured habitat off Sri Lanka.

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